

WHAT IS CLAIMED IS:

1. A liquid image formation apparatus comprising:
  - a latent image carrier which carries a latent image on its surface;
  - 5 a developer carrier which carries a liquid developer consisting of a carrier liquid and toner dispersed therein, on its surface; and
  - an applying unit which applies said liquid developer to said developer carrier in a predetermined width,
  - 10 said liquid image formation apparatus for developing the latent image by said liquid developer carried on said developer carrier, in a development area as an area where said developer carrier and said latent image carrier face each other, further comprising:
  - 15 a removing unit, which removes excess toner on said latent image carrier after development, located downstream said development area in a direction in which the surface of said latent image carrier moves,
  - wherein an area, in which said removing unit removes
  - 20 excess toner, on the surface of said latent image carrier is made broader than an area in which said applying unit applies said liquid developer onto the surface of said latent image carrier.

2. The liquid image formation apparatus according to claim 1,

wherein said removing unit is a removing member which is provided facing said latent image carrier and removes  
5 excess toner on the surface of said latent image carrier by transferring said excess toner on said latent image carrier surface thereto, and said removing unit comprises:

a removing-member cleaning member which is in contact with the surface of said removing member for carrying said  
10 excess toner and removes said excess toner on the surface of said removing member, and

a width in a main scanning direction of said removing-member cleaning member covers the whole area in the width direction with respect to the main scanning  
15 direction of said removing member, and is made wider than a width in the main scanning direction of said removing member.

3. The liquid image formation apparatus according to claim 1, further comprising:

a charger which uniformly charges the surface of said latent image carrier; and

an exposing unit which performs exposure to form an image portion and a non-image portion on a uniformly-charged  
25 area that is uniformly charged by said charger,

wherein said removing unit is a removing member which is provided facing said latent image carrier and removes excess toner on the surface of said latent image carrier by transferring said excess toner on said latent image carrier surface thereto, and

said uniformly-charged area is formed so as to cover the whole area of an area where said removing member faces said latent image carrier.

4. The liquid image formation apparatus according to claim 1, further comprising:

a transfer unit which transfers an image formed on the surface of said latent image carrier after development to a transfer medium,

wherein an area, in which said removing unit removes excess toner, on the surface of said latent image carrier is made broader than a transfer-medium facing area in which said transfer medium faces the surface of said latent image carrier.

5. The liquid image formation apparatus according to claim 1, further comprising:

a transfer unit which transfers an image formed on the surface of said latent image carrier after development to a transfer medium; and

a latent image carrier cleaning unit which cleans the surface of said latent image carrier after the image is transferred to said transfer medium,

wherein said removing unit is a removing member which  
5 is provided in contact with said latent image carrier and removes excess toner on the surface of said latent image carrier by transferring said excess toner on said latent image carrier surface thereto, and

an area, in which said latent image carrier cleaning  
10 unit cleans the surface of said latent image carrier, covers the whole area of the contact area of said removing member with said latent image carrier and is made wider than the width in the main scanning direction of said removing unit.

15 6. The liquid image formation apparatus according to claim 1, further comprising:

an excess toner recycle unit which recycles excess toner removed from the surface of said latent image carrier by said removing unit, for development.

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7. The liquid image formation apparatus according to claim 1, further comprising:

a transfer unit which transfers an image formed on the surface of said latent image carrier after development  
25 to a transfer medium; and

an after-transfer residual toner cleaning unit which cleans residual toner after transfer remaining on the surface of said latent image carrier after an image is transferred to said transfer medium, said apparatus further including:

5        an after-transfer residual toner recycle unit which recycles the after-transfer residual toner removed from the surface of said latent image carrier by said after-transfer residual toner cleaning unit, for development.

10    8.    A liquid developing device which applies a liquid developer consisting of a carrier liquid and toner dispersed therein, to an elastic developing roller, brings said developing roller by pressure into contact with a latent image carrier where an electrostatic latent image is formed,

15    develops the electrostatic latent image using said liquid developer applied to said developing roller, and removes said toner adhering to a background portion of said latent image carrier with a sweep roller,

wherein said developing roller can come into contact

20    with and separate from said latent image carrier.

9.    The liquid developing device according to claim 8, wherein said developing roller and said latent image carrier rotate together with each other when said developing roller

25    comes into contact with or separates from said latent image

carrier.

10. The liquid developing device according to claim 8,  
wherein said developing roller has said liquid developer  
5 adhered to its surface when said developing roller comes  
into contact with or separates from said latent image  
carrier.

11. The liquid developing device according to claim 8,  
10 wherein a predetermined potential is applied to said latent  
image carrier so that toner is prevented from movement from  
the surface of said developing roller to said latent image  
carrier when said developing roller comes into contact with  
or separates from said latent image carrier.

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12. A liquid developing device which applies a liquid  
developer consisting of a carrier liquid and toner dispersed  
therein, to an elastic developing roller, brings said  
developing roller by pressure into contact with a latent  
20 image carrier where an electrostatic latent image is formed,  
develops the electrostatic latent image using said liquid  
developer applied to said developing roller, and removes  
said toner adhering to a background portion of said latent  
image carrier with a sweep roller, wherein the following  
25 relation holds:

$$d1 / v < 0.5$$

where a distance from said developing roller to said sweep roller in the rotating direction of said latent image carrier is  $d1$ , and linear velocity of said latent image carrier is  $v$ , and wherein a unit of the distance  $d1$  is mm and a unit of the linear velocity  $v$  of said latent image carrier is mm/sec.

13. The liquid developing device according to claim 12,  
10 wherein

$d2 / v < 0.7$ , where a distance from said sweep roller to a transfer position in the rotating direction of said latent image carrier is  $d2$ .

15 14. The liquid developing device according to claim 13, wherein said latent image carrier is a photoreceptor formed of amorphous silicon.

15. A liquid developing device comprising:  
20 at least one developer carrier which carries a highly viscous and highly concentrated liquid developer consisting of a carrier liquid and toner dispersed therein; and  
an applying member which applies said liquid developer to said developer carrier,  
25 said liquid developing device for developing a latent

image formed on a latent image carrier by said liquid developer carried on said developer carrier, further comprising:

at least one sweep roller formed of an elastic body  
5 for removing excess developer on said latent image carrier after development, located downstream said developer carrier in a direction in which the surface of said latent image carrier moves;

a nip forming unit which forms a nip between said sweep  
10 roller and said latent image carrier;

a sweep voltage applying unit which applies a voltage to said sweep roller;

a rotation driving unit which drives to rotate said sweep roller;

15 a contact/separation unit which brings said sweep roller into contact with and separates said roller from said latent image carrier; and

a cleaning unit which cleans said sweep roller.

20 16. The liquid developing device according to claim 15, wherein said nip forming unit forms a nip by a pressure control unit for controlling a pressure of said sweep roller against said latent image carrier.



17. The liquid developing device according to claim 16, wherein said pressure control unit has a mechanism that adjusts a pressure.

5 18. The liquid developing device according to claim 15, wherein said sweep voltage applying unit which applies a voltage to said sweep roller is formed of a conductive biasing member, and said biasing member comes into contact with said sweep roller to apply a sweep voltage thereto.

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19. The liquid developing device according to claim 18, wherein said sweep voltage applying unit has a conductive wearing member provided on a contact surface with said sweep roller so that a contact part between said sweep roller and  
15 said sweep voltage applying unit always wears.

20. The liquid developing device according to claim 18, wherein said sweep voltage applying unit applies a sweep voltage to said sweep roller by coming into contact with  
20 a core metal of said sweep roller.

21. The liquid developing device according to claim 15, wherein said rotation driving unit has a latent image carrier end gear disposed in the end part of said latent image carrier;  
25 and a sweep roller end gear disposed in the end part of said

sweep roller so as to be engaged with said latent image carrier end gear, and

said sweep roller end gear drives to rotate said sweep roller.

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22. The liquid developing device according to claim 21, wherein said rotation driving unit drives to rotate said sweep roller so that a surface moving speed of said sweep roller is substantially the same as a surface moving speed of said latent image carrier.

23. The liquid developing device according to claim 21, wherein said rotation driving unit has a one way clutch disposed in said sweep roller end gear.

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24. The liquid developing device according to claim 15, wherein said contact/separation unit is so constructed that said sweep roller is separated from said latent image carrier by a displacing device and said sweep roller is brought into contact with said latent image carrier by a pressure control unit.

25. The liquid developing device according to claim 24, wherein said contact/separation unit is so constructed that said displacing device has a cam and said sweep roller

separates from said latent image carrier through rotation of said cam.

26. The liquid developing device according to claim 15,  
5 wherein said sweep roller is formed in a multilayer structure including a core metal and at least one layer.

27. The liquid developing device according to claim 26,  
wherein said sweep roller formed of an elastic body has a  
10 volume resistivity of  $10^9$  ohms-cm or below.

28. The liquid developing device according to claim 26,  
wherein said sweep roller formed of an elastic body has a  
hardness of 50 degrees (JIS-A) or below.

15 29. The liquid developing device according to claim 26,  
wherein said sweep roller formed of an elastic body does not swell by carrier liquid of developer, nor is impregnated with said carrier liquid.

20 30. The liquid developing device according to claim 26,  
wherein the surface layer of said sweep roller formed of an elastic body is a film layer of 100  $\mu\text{m}$  or below.

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31. The liquid developing device according to claim 26, wherein said sweep roller surface layer formed of an elastic body is a film layer having a volume resistivity of  $10^9$  ohms-cm or below.

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32. The liquid developing device according to claim 15, further comprising:

a development voltage applying unit which applies a voltage to a developer carrier, said voltage producing an electric field between an image portion of a latent image carrier and said developer carrier, and said electric field having a direction that moves toner to said image portion; and

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a sweep voltage applying unit which applies a voltage to a sweep roller, said voltage producing an electric field having a direction that attracts stray excess toner present between a background of said latent image carrier and said sweep roller to said sweep roller, and said electric field being not so strong as said toner adhering to said image portion is peeled.

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33. The liquid developing device according to claim 15, wherein a surface moving speed of a developer carrier is substantially the same as a surface moving speed of said latent image carrier.

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34. A liquid image formation apparatus comprising:  
a latent image carrier;  
a latent image forming unit which forms a latent image  
on said latent image carrier;  
5 a developing unit which visualizes the latent image  
on said latent image carrier; and  
a transfer unit which transfers the visualized image  
on said latent image carrier to a transfer material, said  
liquid image formation apparatus further comprising a liquid  
10 developing device,  
said liquid developing device including:  
at least one developer carrier which carries  
a highly viscous and highly concentrated liquid developer  
consisting of a carrier liquid and toner dispersed therein;  
15 and  
an applying member which applies said liquid  
developer to said developer carrier,  
said liquid developing device for developing  
the latent image formed on said latent image carrier by said  
20 liquid developer carried on said developer carrier, said  
liquid developing device further including:  
at least one sweep roller formed of an elastic  
body for removing excess developer on said latent image  
carrier after development, located downstream said  
25 developer carrier in a direction in which the surface of

said latent image carrier moves;

a nip forming unit which forms a nip between  
said sweep roller and said latent image carrier;

a sweep voltage applying unit which applies a  
5 voltage to said sweep roller;

a rotation driving unit which drives to rotate  
said sweep roller;

a contact/separation unit which brings said  
sweep roller into contact with and separates said roller  
10 from said latent image carrier; and

a cleaning unit which cleans said sweep roller.

35. The liquid image formation apparatus according to  
claim 34, wherein said sweep roller is separated from said  
15 latent image carrier when the liquid developing device or  
liquid image formation apparatus is not in use.

36. A liquid developing device comprising:

at least one developer carrier which carries a highly  
20 viscous and highly concentrated liquid developer consisting  
of a carrier liquid and toner dispersed therein; and

an applying member which applies said liquid developer  
to said developer carrier,

said liquid developing device for developing a latent  
25 image formed on a latent image carrier by said liquid

developer carried on said developer carrier, further comprising:

at least one removing member which removes excess toner and carrier on said latent image carrier after development,  
5 located downstream said developer carrier in a direction in which the surface of said latent image carrier moves; and a cleaning unit that cleans the surface of said removing member as a roller,

wherein said cleaning unit is a blade member, and its  
10 contact position with respect to said roller as said removing member is a central position or lower in the vertical direction.

37. The liquid developing device according to claim 36,  
15 wherein said cleaning blade is disposed so that said cleaning blade is in contact with said sweep roller at a position having an angle  $\theta$  formed with a horizontal surface of said sweep roller, and said cleaning blade is in contact with said sweep roller at an angle  $\alpha$  formed between a tangential  
20 direction at a contact point of said blade with said sweep roller and said blade, and the angle  $\theta$  is made greater than the angle  $\alpha$ .

38. The liquid developing device according to claim 36, wherein said cleaning unit is a rubber member having a JISA hardness within a range from 50 degrees to 80 degrees.

5 39. The liquid developing device according to claim 36, wherein the elastic constant of a material for said cleaning unit is within a range from 100 MPa to 5000 MPa.

40. The liquid developing device according to claim 36,  
10 wherein said cleaning unit has a blade formed of an elastic body, that has a JISA hardness within a range from 50 degrees to 80 degrees, bonded to a thin plate as a rigidity imparting member.

15 41. The liquid developing device according to claim 36, wherein said cleaning member is subjected to oil-repellent treatment.

42. The liquid developing device according to claim 36,  
20 further comprising a conveying unit, which moves toner after being removed in an axial direction, disposed close to said cleaning blade.



43. The liquid developing device according to claim 36, wherein an angle of said cleaning blade is formed in a minus direction with respect to a vertical direction, and a moving member is disposed in the vicinity of said cleaning blade.

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44. The liquid developing device according to claim 36, wherein said cleaning blade and its holding part are electrically floated from the main body of said device, and a bias is applied to said cleaning blade so that the potential  
10 is substantially the same as that of a developer carrier.

45. The liquid developing device according to claim 36, wherein said cleaning blade and its holding part are electrically floated from the main body of said device when  
15 the material of said cleaning blade has an electrical resistivity of  $10^{12}$  ohms or above, and this part is grounded.

46. A liquid developing device comprising a developer carrier which carries a liquid developer consisting of a  
20 carrier liquid and toner dispersed therein, said liquid developing device for supplying said liquid developer carried on said developer carrier to a latent image carrier to develop a latent image, further comprising:

at least one sweep roller, which removes excess liquid  
25 developer adhering to the surface of said latent image

carrier after development, located downstream the surface of said latent image carrier, wherein said sweep roller is formed of an elastic body.

5 47. The liquid developing device according to claim 46, wherein cylindrical members each having a smaller outer diameter than the outer diameter of said sweep roller are provided in both ends of said sweep roller, and a nip width, formed when said sweep roller is brought into contact with  
10 said latent image carrier, is adjusted to an appropriate one.

48. The liquid developing device according to claim 46, wherein said sweep roller is formed in a multilayer structure  
15 including a core metal and an elastic layer with at least one layer.

49. The liquid developing device according to claim 48, wherein said sweep roller has a volume resistivity of  $10^9$   
20 ohms-cm or below.

50. The liquid developing device according to claim 48, wherein said sweep roller formed of said elastic body has a hardness of 50 degrees (JIS-A) or below.

51. The liquid developing device according to claim 48, wherein said sweep roller formed of said elastic body does not swell by said carrier liquid, nor is impregnated with said carrier liquid.

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52. The liquid developing device according to claim 48, wherein the surface of said sweep roller has a surface roughness value of 3  $\mu\text{m}$  or below.

10 53. The liquid developing device according to claim 48, wherein said elastic layer is formed of urethane base resin as its main component.

54. The liquid developing device according to claim 48,  
15 wherein the surface of said sweep roller is a film layer of 100  $\mu\text{m}$  or below.

55. The liquid developing device according to claim 48, wherein the surface of said sweep roller is a film layer  
20 having a volume resistivity of  $10^9$  ohms-cm or below.

56. The liquid developing device according to claim 48, wherein said elastic body is a foam.

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57. The liquid developing device according to claim 48, wherein said elastic layer is formed of silicone base resin as its main component.

5 58. The liquid developing device according to claim 46, further comprising:

a development voltage applying unit which applies a voltage to said developer carrier, said voltage producing an electric field having a direction that moves liquid  
10 developer to said latent image carrier when a latent image on said latent image carrier is developed with said liquid developer carried on said developer carrier; and

a sweep voltage applying unit which applies a voltage to said sweep roller, said voltage producing an electric  
15 field having a direction that attracts excess liquid developer or toner to said sweep roller in order to remove said excess liquid developer or toner adhering to or floating around the surface of said latent image carrier or its periphery after development, and said electric field being  
20 not so strong as said toner adhering to the developed latent image on said latent image carrier is peeled.

59. The liquid developing device according to claim 46, wherein a surface moving speed of said developer carrier  
25 is substantially the same as a surface moving speed of said

latent image carrier.

60. The liquid developing device according to claim 46,  
wherein a surface moving speed of said sweep roller is  
5 substantially the same as a surface moving speed of said  
latent image carrier.

61. The liquid developing device according to claim 46,  
wherein said toner contains pigment, and a thickness of a  
10 liquid developer to be applied to said developer carrier  
is set so that a pigment content in said toner carried on  
the surface of said developer carrier per square cm is within  
a range from 0.1  $\mu$ g to 2  $\mu$ g.

15 62. The liquid developing device according to claim 46,  
further comprising a cleaning unit which cleans the surface  
of said developer carrier; and a cleaning unit which cleans  
the surface of said sweep roller.

20 63. The liquid developing device according to claim 46,  
wherein said developer carrier is a belt-like carrier.

64. The liquid developing device according to claim 63,  
wherein said developer carrier has a hardness of 60 degrees  
25 (JIS-A) or below.

65. The liquid developing device according to claim 46,  
wherein said developer carrier is a roller-like carrier.

66. The liquid developing device according to claim 65,  
5 wherein said developer carrier has a hardness of 40 degrees  
(JIS-A) or below.

67. The liquid developing device according to claim 65,  
wherein an electrical resistivity between the surface of  
10 said roller-like developer carrier and a roller shaft of  
said developer carrier is  $10^9$  ohms or below.

68. A liquid image formation apparatus comprising: a  
latent image carrier; a latent image forming unit which forms  
15 a latent image on said latent image carrier; a developing  
unit which visualizes the latent image on said latent image  
carrier; and a transfer unit which transfers the visualized  
image on said latent image carrier to a transfer material,  
said liquid image formation apparatus using a liquid  
20 developing device,

said liquid developing device including:

a developer carrier, as said developing unit, which  
carries a liquid developer consisting of a carrier liquid  
and toner dispersed therein, said liquid developing device  
25 for supplying said liquid developer carried on said developer

carrier to said latent image carrier to develop a latent image, said device further including:

at least one sweep roller, which removes excess liquid developer adhering to the surface of said latent image carrier after development, located on the downstream side of the surface of said latent image carrier, wherein said sweep roller is formed of an elastic body.

69. A liquid developing device comprising a developer carrier which carries a liquid developer consisting of a carrier liquid and toner dispersed therein, said liquid developing device for supplying said liquid developer carried on said developer carrier to a latent image carrier to develop a latent image,

wherein said developer carrier is formed of urethane base resin so as to have conductivity, and

at least one sweep roller, which removes excess liquid developer adhering to the surface of said latent image carrier after development, is provided on the downstream side of the surface of said latent image carrier.

70. The liquid developing device according to claim 69, wherein said developer carrier is a belt-like carrier.

71. The liquid developing device according to claim 70, wherein said developer carrier has a hardness of 60 degrees (JIS-A) or below.

5 72. The liquid developing device according to claim 69, wherein said developer carrier is a roller-like carrier.

73. The liquid developing device according to claim 72, wherein said developer carrier has a hardness of 40 degrees  
10 (JIS-A) or below.

74. The liquid developing device according to claim 72, wherein an electrical resistivity between the surface of said roller-like developer carrier and a roller shaft of  
15 said developer carrier is  $10^9$  ohms or below.

75. The liquid developing device according to claim 69, wherein the surface of said developer carrier has a surface roughness value of 3  $\mu\text{m}$  or below.

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76. The liquid developing device according to claim 69, wherein a conductive surface layer is provided on said developer carrier.

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77. The liquid developing device according to claim 69, wherein the surface of said latent image carrier is formed of amorphous silicon.

5 78. The liquid developing device according to claim 69, further comprising:

a development voltage applying unit which applies a voltage to said developer carrier, said voltage producing an electric field having a direction that moves said liquid  
10 developer to said latent image carrier when a latent image on said latent image carrier is developed with said liquid developer carried on said developer carrier; and

a sweep voltage applying unit which applies a voltage to said sweep roller, said voltage producing an electric  
15 field having a direction that attracts excess liquid developer or toner to said sweep roller in order to remove said excess liquid developer or toner adhering to or floating around the surface of said latent image carrier or its periphery after development, and said electric field being  
20 not so strong as said toner adhering the developed latent image on said latent image carrier is peeled.

79. The liquid developing device according to claim 69, wherein a surface moving speed of said developer carrier  
25 is substantially the same as a surface moving speed of said

latent image carrier.

80. The liquid developing device according to claim 69,  
wherein a surface moving speed of said sweep roller is  
5 substantially the same as a surface moving speed of said  
latent image carrier.

81. The liquid developing device according to claim 69,  
wherein said toner contains pigment, and a thickness of a  
10 liquid developer to be applied to said developer carrier  
is set so that a pigment content in said toner carried on  
the surface of said developer carrier per square cm is within  
a range from 0.1  $\mu\text{g}$  to 2  $\mu\text{g}$ .

15 82. The liquid developing device according to claim 69,  
further comprising a cleaning unit which cleans the surface  
of said developer carrier; and a cleaning unit which cleans  
the surface of said sweep roller.

20 83. A liquid image formation apparatus comprising: a  
latent image carrier; a latent image forming unit which forms  
a latent image on said latent image carrier; a developing  
unit which visualizes the latent image on said latent image  
carrier; and a transfer unit which transfers the visualized  
25 image on said latent image carrier to a transfer material,

said liquid image formation apparatus using a liquid developing device,

said liquid developing device comprising:

a developer carrier as said developing unit which  
5 carries a liquid developer consisting of a carrier liquid and toner dispersed therein, said liquid developing device for supplying said liquid developer carried on said developer carrier to said latent image carrier to develop a latent image,

10 wherein said developer carrier is formed of urethane base resin so as to have conductivity, and

at least one sweep roller, which removes excess liquid developer adhering to the surface of said latent image carrier after development, is provided on the downstream  
15 side of the surface of said latent image carrier.